New Thermal Infrared Remote Sensing Instruments

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Both high spatial resolution and multispectral capability in the wavelength range 3-14 μm are required for a number of important scientific, operational and commercial applications.

The basic physical variables that are determined from these measurements are surface temperature, and surface spectral signatures. High spatial resolution data is required both for the measurement, monitoring, and early detection of changes of the land surface at a scale of human activities and for determining physical proesses that occur at this scale. High spatial resolution thermal infrared measurements provide important inputs for algorithms that calculate surface energy, water fluxes, and soil moisture. Other applications which require high spatial resolution temperature include such diverse studies as monitoring of volcanoes, geothermal areas, and wildfires, determination of cloud top temperatures, vegetation water stress, wetland extent, evapotranspiration, snow melt conditions, coastal studies, and determination of thermophysical properties such as thermal inertia.

In addition to being required for the derivation of accurate temperature determination, the emissivity data can also be used for geological studies of a scientific and commercial nature, including stratigraphic and structural mapping and mineral exploration, for soil mapping and for studies of soil degradation and land use change, and for hazard monitoring and mapping. Because multispectral thermal infrared data have not been generally available in the past, the user community is only just becoming aware of their potential.

One of the first spaceborne instruments that will provide high spatial resolution multispectral thermal data is the Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER), currently scheduled to fly in Earth orbit on the first platform of NASA's Earth Observing System (EOS-A). The instrument is being provided by the Japanese Government Ministry of International Trade and Industry (MITI). The ASTER project is implemented through the Earth Resources Satellite Data Analysis Center (ERSDAC), and Japan Resources Observation System Organization (JAROS), which are nonprofit organizations under MITI. ASTER will have three bands in the visible and near infrared (VNIR) spectral range (0.5—1.0 μm) with 15 m resolution, six bands in the shortwave infrared (SWIR) spectral range (1.6—2.5 μm) with 30 m spatial resolution, and five bands in the thermal infrared (TIR) spectral range (8—12 μm), with 90 m resolution. Another spaceborne instrument under development is the U.S. Department of Energy's Multispectral Thermal Imager (MTI), with 15 bands between 0.45 and 10.7 μm. The spatial resolution is very high (5—20 m), but the instrument will have quite limited data acquisition, only a few scenes a day. In addition, hyperspectral aircraft instruments such as SEBASS and AHI are becoming available opening exciting new remote sensing possibilities.